

# AI-Powered USB Handbook

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USB

*AI-Powered USB Handbook Team*

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# 1. AI-Powered USB Handbook

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## AI-Powered USB Handbook

AI-Powered USB Handbook	USB	USB 3.2 Gen 2x2	Thunderbolt 4 ( 4)
Type-C			

## 1.1

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- -
- **USB** - USB
- **USB** -
- **Thunderbolt** -
- - USB PD
- -

## 1.2

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- 
- 
- 
-

## 2. 1 (Introduction)

2.1

## USB (Universal Serial Bus) Type-C

USB

USB 3.2 Gen 2x2

**AI-Powered USB Handbook**

USB

AI

2.2

- 4 USB4
  - USB

2.3

- 1.
  2.           USB 1.0    USB4
  3.           Intel       Thunderbolt        USB
  4.           USB PD      PPS
  - 5.

## 3. 2 USB (USB Connector Types)

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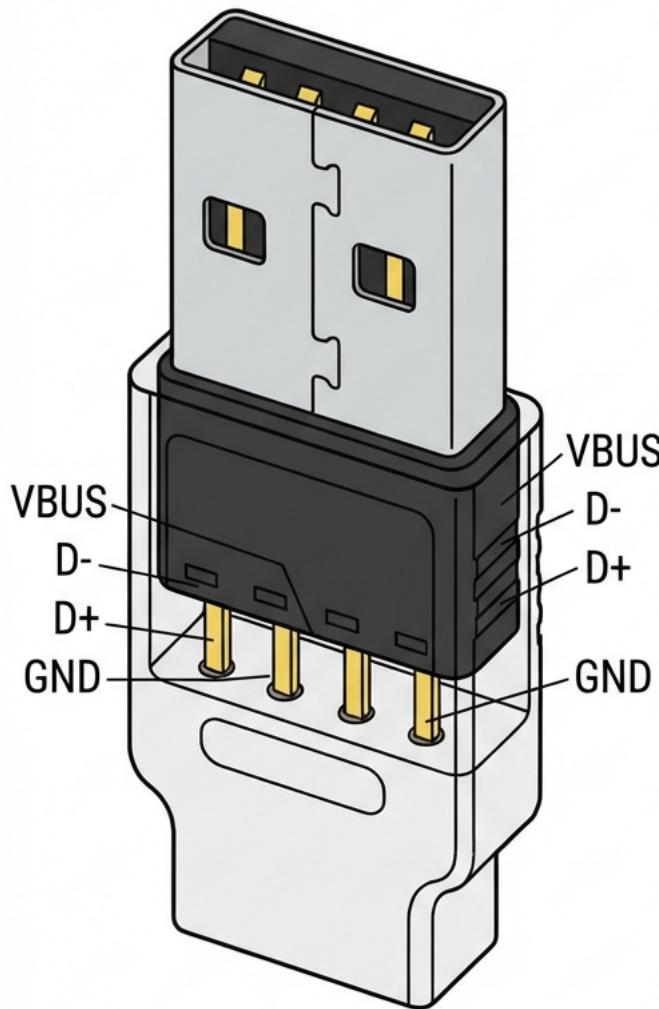
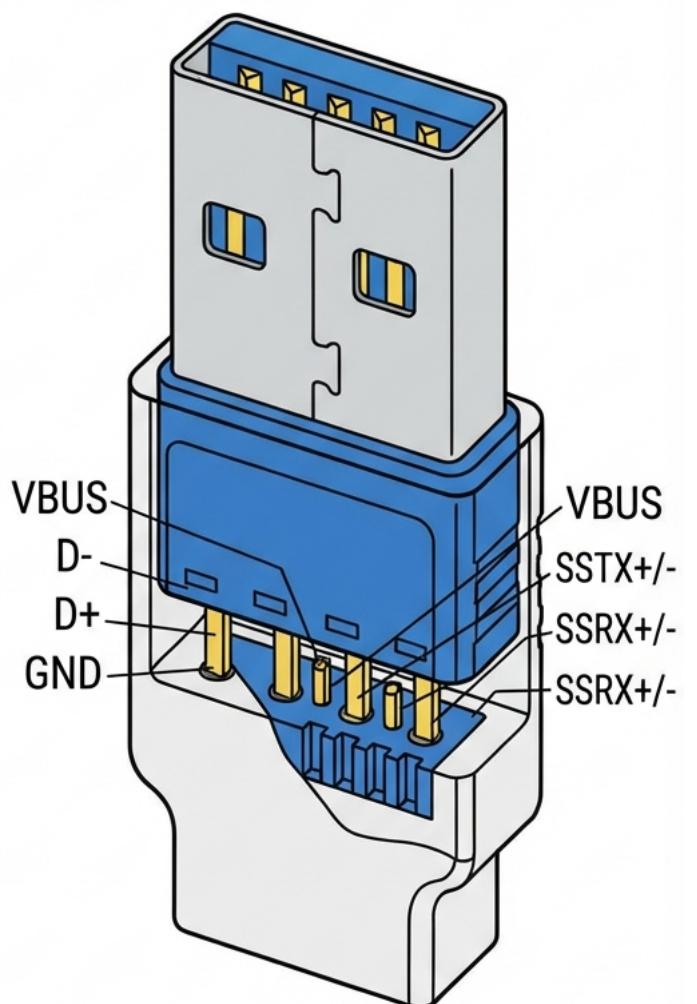
USB

### 3.1 USB Type-A

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USB

- 
- 
- **USB 2.0** 4
- **USB 3.0+** 5 9

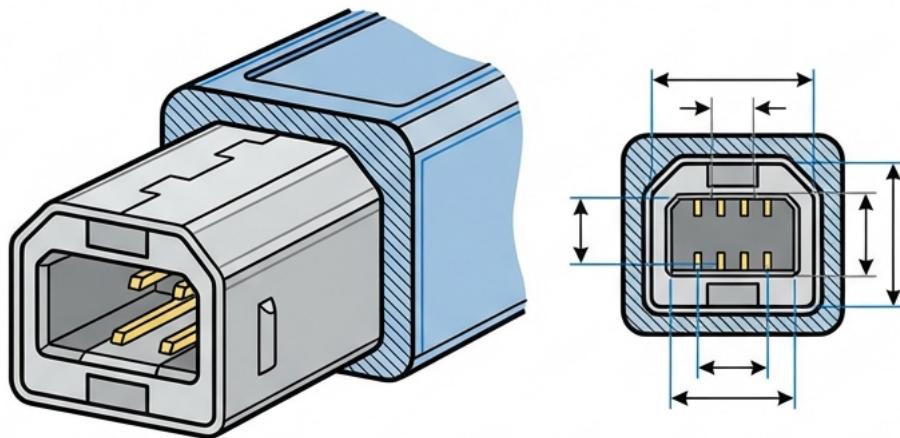
**USB 2.0 Type-A****USB 2.0 Type-A****USB 3.0 Type-A  
(SuperSpeed)****USB 3.0 Type-A  
(SuperSpeed)**

## 3.2 USB Type-B

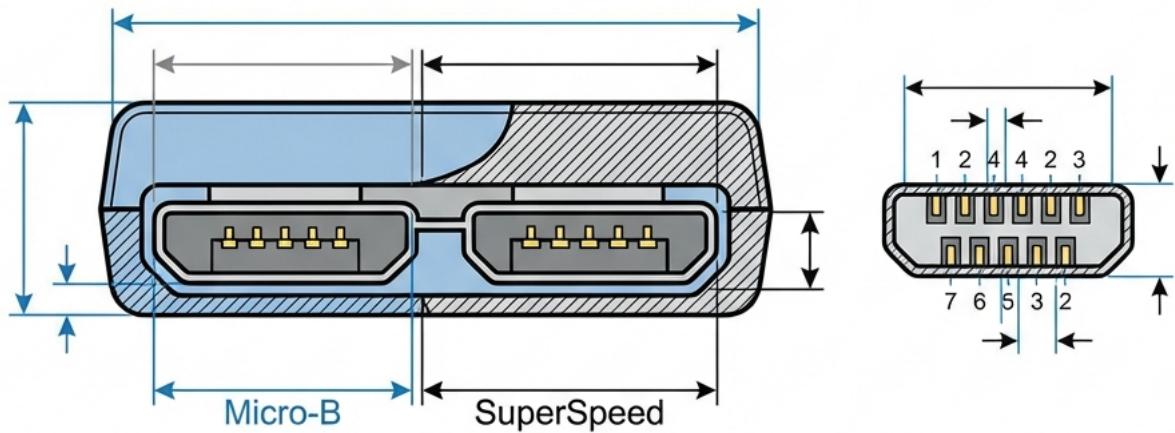
- Standard-B
- Micro-B (USB 3.0)

Elements

USB 3.0



**USB Standard-B  
(Printer)**

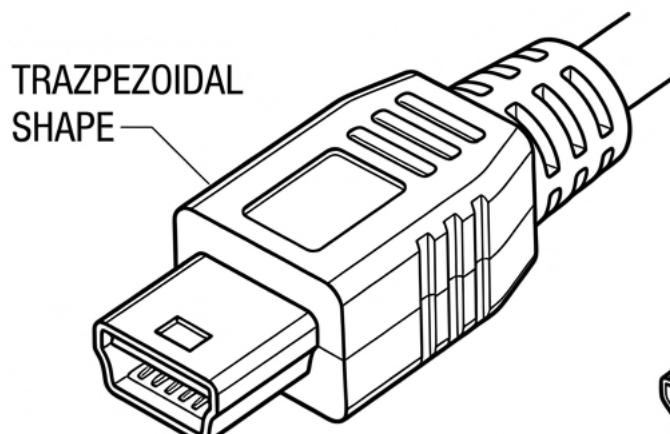


**USB Micro-B SuperSpeed  
(External HDD)**

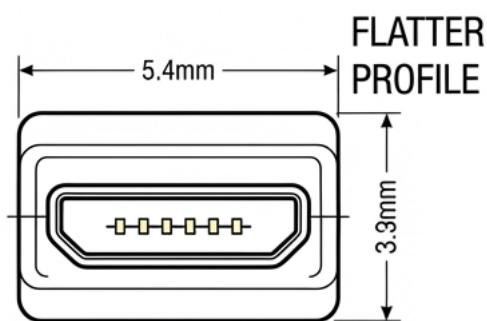
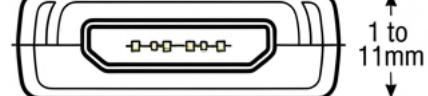
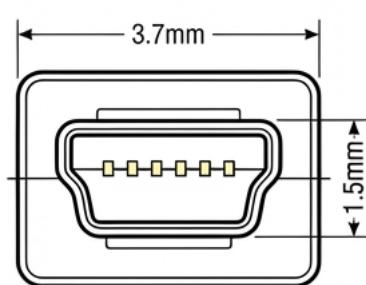
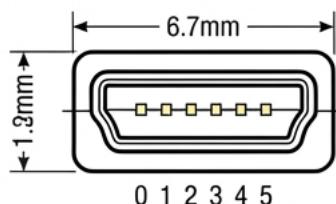
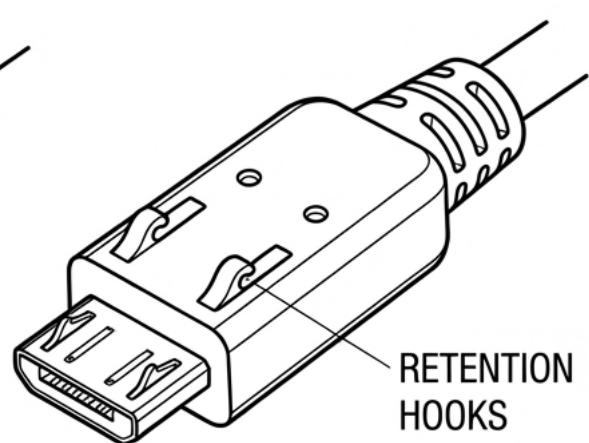
### 3.3 Mini USB & Micro USB

- **Mini USB** MP3
- **Micro USB** USB 2.0

# MINI USB



# MICRO USB



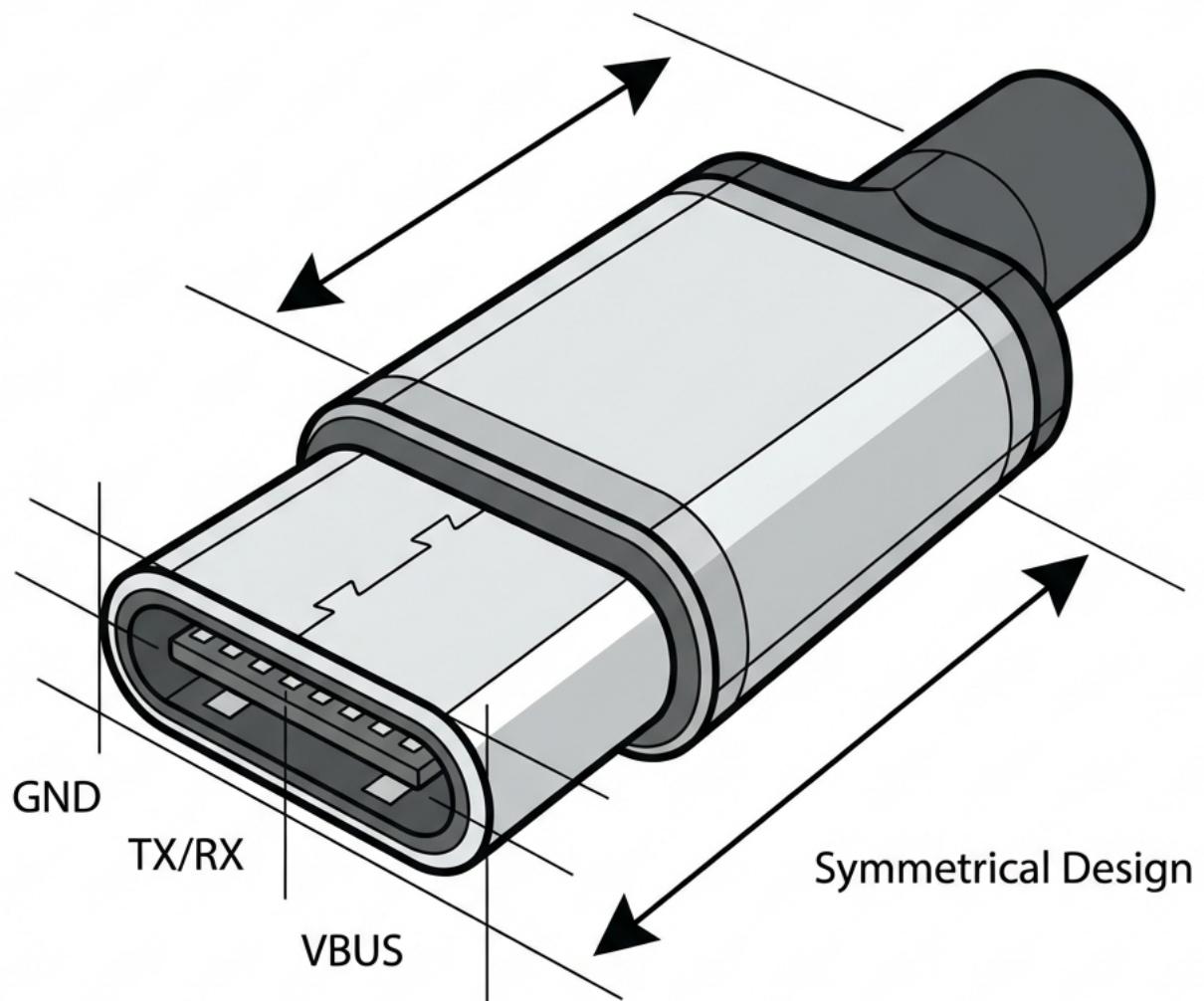
# MINI USB

# MICRO USB

## 3.4 USB Type-C

- DP Alt Mode      240W      USB PD
- 24                22              CC (Configuration Channel)
- **Type-C**              Type-C      USB 2.0

4



## 4. 3 USB (USB Transfer Protocols)

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USB                    USB-IF (USB )

### 4.1

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- **USB 1.0 / 1.1:**
- **Low Speed:** 1.5 Mbps ( )
- **Full Speed:** 12 Mbps
- **USB 2.0:**
- **High Speed:** 480 Mbps         " "

### 4.2 USB 3.x

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	<b>(2013)</b>	<b>(2019)</b>			
<b>USB 3.0</b>	USB 3.1 Gen 1	<b>USB 3.2 Gen 1</b>	USB 3.0 / 5Gbps	5 Gbps	8b/10b
N/A	<b>USB 3.1 Gen 2</b>	<b>USB 3.2 Gen 2</b>	USB 3.1 / 10Gbps	10 Gbps	128b/132b
N/A	N/A	<b>USB 3.2 Gen 2x2</b>	USB 3.2 / 20Gbps	20 Gbps	128b/132b

USB 3.2 Gen 2x2      Type-C      Type-C

### 4.3 USB4

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USB4    Intel    Thunderbolt 3

- **USB4 Gen 2x2:** 20 Gbps
- **USB4 Gen 3x2:** 40 Gbps ( )
- 
- **(Tunneling)**                    (USB 3.2)    (DisplayPort)    PCIe
- USB 3.2    USB 2.0    Thunderbolt 3

## 5. 4 Thunderbolt ( ) (Thunderbolt Technology)

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Thunderbolt Intel Apple " " " "

### 5.1 Thunderbolt 3 ( 3)

- USB Type-C
- 40 Gbps
- PCIe x4 ( ) DisplayPort ( 5K/8K ) USB
- 3 USB 3.x USB

### 5.2 Thunderbolt 4 ( 4)

4 40 Gbps

#### 5.2.1 4 vs 3

<b>1. PCIe</b>	4	PCIe	<b>32 Gbps</b> ( 3 16 Gbps)	(eGPU)	SSD
2.	4	<b>4K</b>	<b>8K</b> ( 3 4K)		
3.		Intel VT-d DMA	DMA		
4.	4	<b>(Hub)</b>	1 3 3	(Daisy Chain)	

### 5.3 Thunderbolt vs USB4

- USB4 3
- 
- **USB4** " " 20Gbps 40Gbps PCIe
- **Thunderbolt 4** " " 40Gbps PCIe Intel
- **Thunderbolt 4 USB4** " "

## 6. 5 (Charging & Power Delivery)

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USB 2.5W (5V 0.5A) 240W

### 6.1

- **USB BC 1.2 (Battery Charging)** 7.5W (5V 1.5A)
- QC (Quick Charge) OPPO VOOC SCP/FCP

### 6.2 USB PD (Power Delivery)

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USB PD USB-IF Type-C

#### 6.2.1

- **PD 2.0 / 3.0:** 100W (20V 5A)
- 5V, 9V, 15V, 20V
- **PD 3.1: EPR (Extended Power Range)** 240W
- 28V, 36V, 48V

#### 6.2.2 PPS (Programmable Power Supply)

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PPS PD 3.0 20mV - " " PPS

### 6.3 (E-Marker )

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Type-C

- **3A** C-to-C 60W (20V 3A)
- **5A E-Marker** " 5A " 100W (20V 5A)
- **EPR** PD 3.1 240W

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7. 6

## (FAQ & Common Misconceptions)

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### 7.1 Q: Type-C

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A: 1. USB 2.0 E-Marker 3A 65W/100W 2. PD  
VOOC 10W 3.

### 7.2 Q: Type-C

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A: Type-C C - **9.9** + USB 2.0 - USB 3.2 (10Gbps) + 4K + 100W - **4** 40Gbps  
+ 8K + 240W Logo

### 7.3 Q: 65W

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A: USB PD " " " 9V 2A " 18W PD 5V 1A 5V 2A

### 7.4 Q:

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A: - 5A 4 - USB 3.2